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A taxonomic study on the genus *Tectodamaeus* Aoki (Acari, Oribatida, Damaeidae), with description of two new species from China

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Abstract

Two new species of the genus *Tectodamaeus* from Yunnan and Anhui Province respectively, China are described, *Tectodamaeus daliensis* **sp. n.**, *Tectodamaeus longus* **sp. n.** Nine new combinations, *Tectodamaeus costanotus* (Wang & Norton) **comb. n.,** *Tectodamaeus exspinosus* (Wang & Norton) **comb. n.**, *Tectodamaeus wulongensis* (Wang & Cui) **comb. n.**, *Tectodamaeus brevisetus* (Wang) **comb. n.**, *Tectodamaeus spiniger* (Wang) **comb. n.**, *Tectodamaeus exsertus* (Wang) **comb. n.**, *Tectodamaeus yaoi* (Wang) **comb. n.,** *Tectodamaeus furcatus* (Wang & Lu) **comb. n.**, *Tectodamaeus cuii* (Wang & Lu) **comb. n.** are presented. The subgenus *Damaeus* (*Tectodamaeus*) as a genus in the oribatid mite family Damaeidae was reestablished. A key is given to distinguish all the species of the genus. The type specimens of the new species are deposited in the Institute of Entomology, Guizhou University (IEGU).

Keywords

Oribatida, Damaeidae, *Tectodamaeus*, *Damaeus*, new species, new combination, China

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Introduction

The genus *Tectodamaeus* (Acari, Oribatida, Damaeidae), was established by Aoki (1984) for a single species, *Tectodamaeus armatus* Aoki, 1984, because there are only 2 setae on genu IV, while all the known genera of Damaeidae have 3~4 setae on the segment. In 1988, Enami and Aoki described the second species, *Tectodamaeus striatus*. In 1989, Wang and Norton described two species from South China, *Damaeus exspinosus*, *Damaeus costanotus*. Later, Wang and Hu (1992) described a new species *Damaeus wulongensis*. In 1994, Wang and Cui described another five species, proposed two new combinations and *Tectodamaeus* was treated as a subgenus of *Damaeus*.

In this paper, the subgenus *Damaeus* (*Tectodamaeus*) as a genus in the oribatid mite family Damaeidae was reestablished. Two new species of *Tectodamaeus* from China are described and illustrated and nine new combinations present. A key to all known species of this genus is also provided. The type specimens of new species are deposited in the Institute of Entomology, Guizhou University, Guiyang, Guizhou (IEGU).

Results

Genus *Tectodamaeus* Aoki

Tectodamaeus Aoki, 1984: 110–111; Enami and Aoki 1988:33–36
Damaeus (*Tectodamaeus*) Wang and Cui, 1994: 62–63; Lu and Wang, 1995: 81–82; Lu and Wang, 1995:59–62
Type species: *Tectodamaeus armatus* Aoki, 1984.

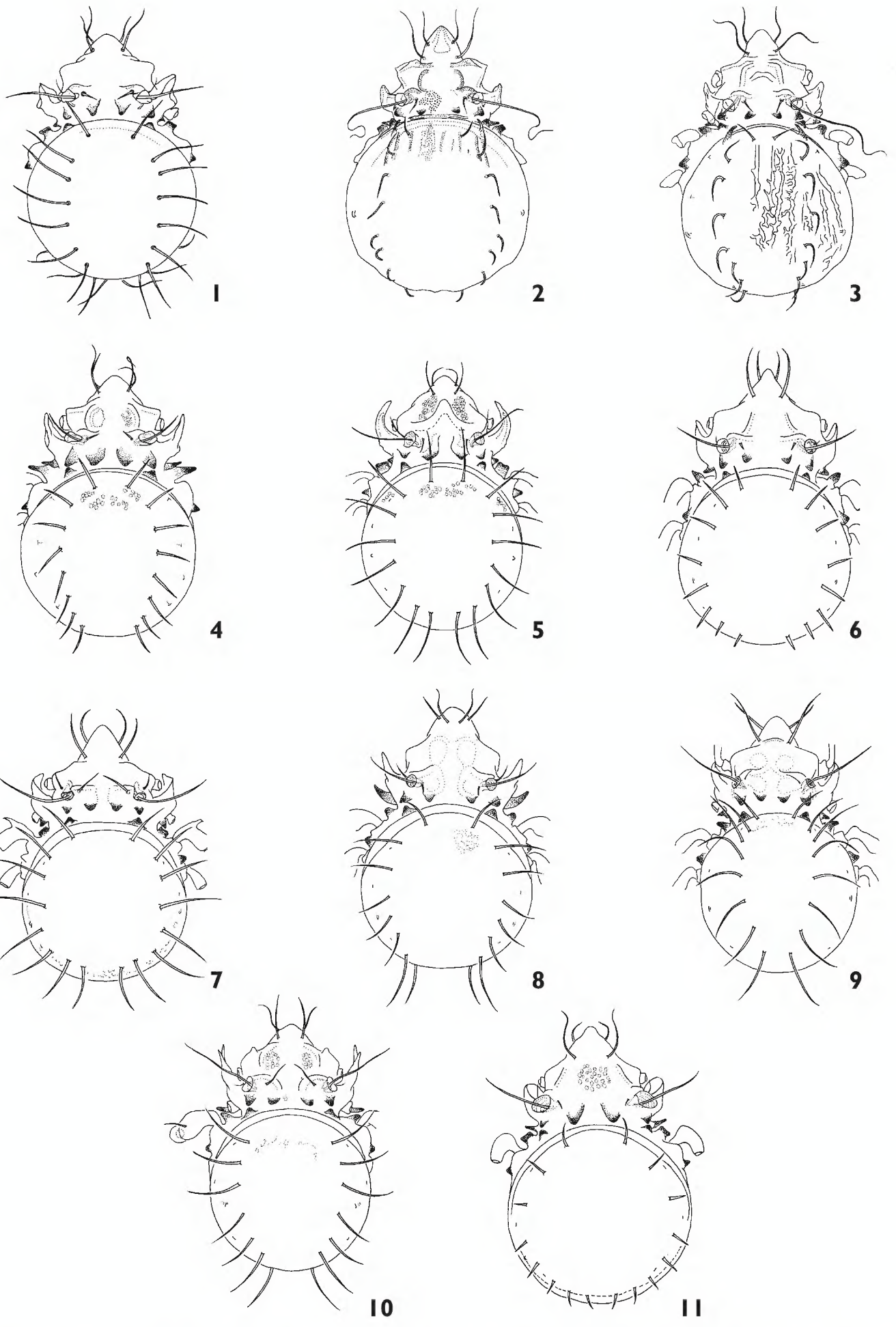
Description. Large, dark-colored damaeid mites with long legs. Three pairs of tubercles (Da, Ba and Bp) on prodorsum and 4 paris of tubercles (E2a, E2p, Va and Vp) on ventral side well developed. Propodolateral apophysis (P) always present, Discidium present. Epimeral setation: 3–1–3–4. Leg IV always longer than total body length. Genu IV bearing only 2 setae. Setae *d* of genu present on legs I-III. Solenidion of tibia has no protecting seta *d* on legs I-IV.

Diagnosis. *Tectodamaeus* resembles *Damaeus* Koch,1836 in general appearance, but can be distinguished from latter by having only 2 setae on genu IV and Setae *d* of genu present on legs I-III.

Distribution. Oriental Region, Palaearctic region.

Key to species of the genus *Tectodamaeus*

1 Spinae adnatae present (Figs 2, 3, 18) **2**
– Spinae adnatae absent (Figs 1, 4–12) **4**



Figures 1–11. 1 *Tectodamaeus armatus* (Aoki) **2** *Tectodamaeus striatus* Enami & Aoki (after Enami and Aoki 1988) **3** *Tectodamaeus costanotus* (Wang & Norton); **4** *Tectodamaeus exspinosus* (Wang & Norton) (after Wang and Norton 1989) **5** *Tectodamaeus wulongensis* (Wang & Cui) **6** *Tectodamaeus brevisetus* (Wang) **7** *Tectodamaeus spiniger* Wang (after Wang and Cui 1994) **7a** unusually tubercles **8** *Tectodamaeus exsertus* Wang (after Wang and Cui 1994) **9** *Tectodamaeus yaoi* (Wang) **10** *Tectodamaeus furcatus* Wang & Lu (after Wang and Lu 1995a) **11** *Tectodamaeus cuii* Wang & Lu (after Wang and Lu 1995b).

2 Legs are very long, especially leg IV (Figs 20–23) ..... ***T. longus* sp. n.**
– Legs are not very long **3**
3 Existing striation in the anterior part of notogaster (Fig. 2) ..... ***T. striatus***
– Existing striation over all the surface of notogaster (Fig. 3) ..... ***T. costanotus* (Wang & Norton) comb. n.**
4 Tubercle Sp slightly acute at tip, peach-shaped (Fig. 6) ..... ***T. brevisetus* (Wang) comb. n.**
– Tubercle Sp rectangular, triangle or anvil-shaped (Figs 1, 4, 5, 7–12) **5**
5 Tubercle Sp triangular (Fig. 9) ..... ***T. yaoi* (Wang) comb. n.**
– Tubercle Sp rectangular or anvil-shaped (Figs 1, 4, 5, 7, 8, 10–12) **6**
6 Propodolateral apophysis(P) bowl-like (Fig. 11) ..... ***T. cuii* (Wang & Lu) comb. n.**
– Propodolateral apophysis(P) not bowl-like (Figs 1, 4, 5, 7, 8, 10, 12) **7**
7 Propodolateral apophysis(P) bent ventrad, horn-shaped (Fig. 5) ..... ***T. wulongensis* (Wang & Cui) comb. n.**
– Propodolateral apophysis(P) bent anteriad (Figs1, 4, 7, 8, 10, 12) **8**
8 Femora and trochanter with unusually tubercles (Fig. 7) ..... ***T. spiniger* (Wang) comb. n.**
– Femora and trochanter without unusually tubercles **9**
9 The length of tubercle Sa larger than Sp (Fig. 8) ..... ***T. exsertus* (Wang) comb. n.**
– The length of tubercle Sp larger than Sa (Figs 1, 4, 10, 12) **10**
10 Propodolateral apophysis(P) furcated at the tip (Fig. 10) ..... ***T. furcatus* (Wang & Lu) comb. n.**
– Propodolateral apophysis(P) not furcated at the tip (Figs 1, 4, 12) **11**
11 Tubercle Sp somewhat anvil-shaped (Fig. 4) ..... ***T. exspinosus* (Wang & Norton) comb. n.**
– Tubercle Sp rectangular at base (Figs1, 12) **12**
12 Notogastral setae acuminate , roughened with dense warts and distal half finely barbed, c_1 directed anteriad. (Fig. 12) ..... ***T. daliensis* sp. n.**
– Notogastral setae thick,smooth.(Fig. 1) ..... ***T. armatus***

***Tectodamaeus daliensis* sp. n.**
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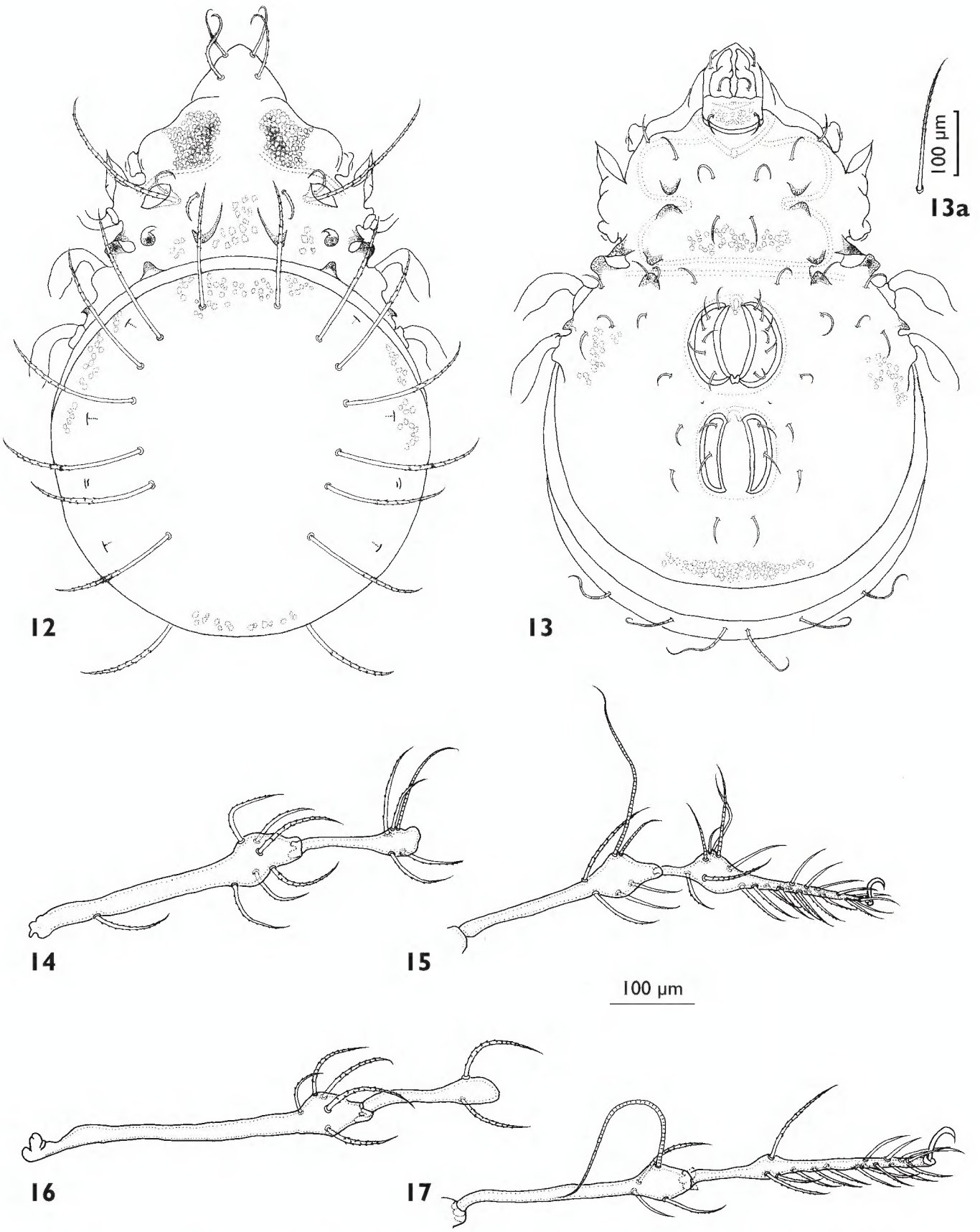
Figs 12–17

Measurements. Mean ventral length: 817 μm (range 785–822); Mean notogastral width: 722 μm (range 695–786).

Integument. Microtuberculate on all enantiophyses and apophyses, rostrum, lateral prodorsum and around leg acetabula. Cerotegument mostly filamentous, long, thick, dense on most of body and legs, except center of notogaster.



Figures 12–17. *Tectodamaeus daliensis* sp. n. **12** adult, dorsal view **13** adult, ventral view **13a** the setae of notogaster **14** femur and genu of leg I; **15** tibia and tarsus of leg I; **16** femur and genu of leg IV; **17** tibia and tarsus of leg IV.

Prodorsum. Three pairs tubercles (Da, Ba and Bp) well developed. Propodolateral apophysis (P) strongly developed, pedotectum-like. Setae *le* with small, coarse barbs, those of *ro* smooth, both setae attenuate, mutual distance of *ro* slightly less than that of *le*. Setae *in* short, dark brown, with small barbs and roughened. Exobothridial setae relatively long, undulating attenuate. Sensillus (about 329µm) dark, attenuate, with sparse, fine, conspicuous barbs, tip acuminate.

Notogaster. Hemispherical, adherent debris, held away from notogastral surface. Notogastral setae of *c*-, *l*-, *h*- series inserted on distinct tubercles. Setae relatively large, thick, brown, acuminate, roughtened with dense warts and distal half finely barbed. c_1 (about 150 µm) directed anterodorsad, c_2 (about 188 µm) dorsolaterad. *l*- and *h*-series (mostly 200–235µm) erect from surface, slightly curved posterolaterad. Mutual distance of setae c_2 2 times that of c_1. Pseudanal setae undulating attenuate,conspicuous barbed. ps_1 somewhat darkened and directed posterolaterad, ps_2 and ps_3 curved laterad. Order in length of the thicker setae: $c_1 < c_2 = h_2 = h_3 = la < lp < lm < h_1$.

Ventral region. Coxisterna I with medial pit and associated groove. Enantiophyses E2 and V present. E2a small, broadly curved tubercle, represented by low, broadly curved ridge, E2p and Va all represented by broad ridge. Vp carrying seta 3*b*, 4*b*. Lateral margin of coxisternum I and II strongly contoured giving appearance of ridge in transmitted light. Tubercle Sa broadly triangular with narrowly rounded tip, Sp broadly rounded or subquadrangular, in lateral aspect Sp twice as broad as Sa. Discidium small than Sp, directed posterolaterad. Ventral setae smooth. Coxisternal setation: 3 – 1–3 – 4. Anogenital region normal, seta ad_3 close to anal valves. Raised medial band of anal valve distinct, with undercut lateral margin, fissure *ian* minute, represented by small, inconspicuous pore in anterolateral corner of valve. Anal aperture appreciably narrower than genital one.

Legs. Relative lengths (I-IV) 1: 0.77: 0.85: 1.06. Leg IV 1.38 times ventral body length. Femur IV 2.5 times length of trochanter IV, proximal stalk 3 times length of bulb. Leg chaetotaxy (famulus included, solenidia in parentheses) – I: 1–7–4(1)–4(2)–21(2); II: 1–6–4 (1)– 4(1)–18 (2); III: 2–5–3(1)–3(1)–18; IV: 1–5–2–3(1)–15. Setae *d* of genu shorter than respective coupled solenidion δ. Tibia solenidia φ of leg IV is long, tibial solenidion φ_1 on leg I about 4 times as long as φ_2.

Type Material. 1 Holotype and 14 Paratypes, leaf litter, Mt.Cang, Dali (25°43'18.19"N, 100°11'33.78"E), Yunnan province, China. 11 December 2007, coll. Yi Yan (IEGU).

Remarks. The new species is similar to *Tectodamaeus armatus* Aoki, but is easily distinguished from the latter mainly by the setae of notogaster, roughened with dense warts and distal half finely barbed. The shape of sensilluse and tubercles (Sp, Da and Ba) and leg chaetotaxy are also different. The new species is also similar to *T. spiniger* (Wang), but the former differs from the latter by different notogastral setae.

Etymology. The species name is derived from the name of type locality.

***Tectodamaeus longus* sp. n.**

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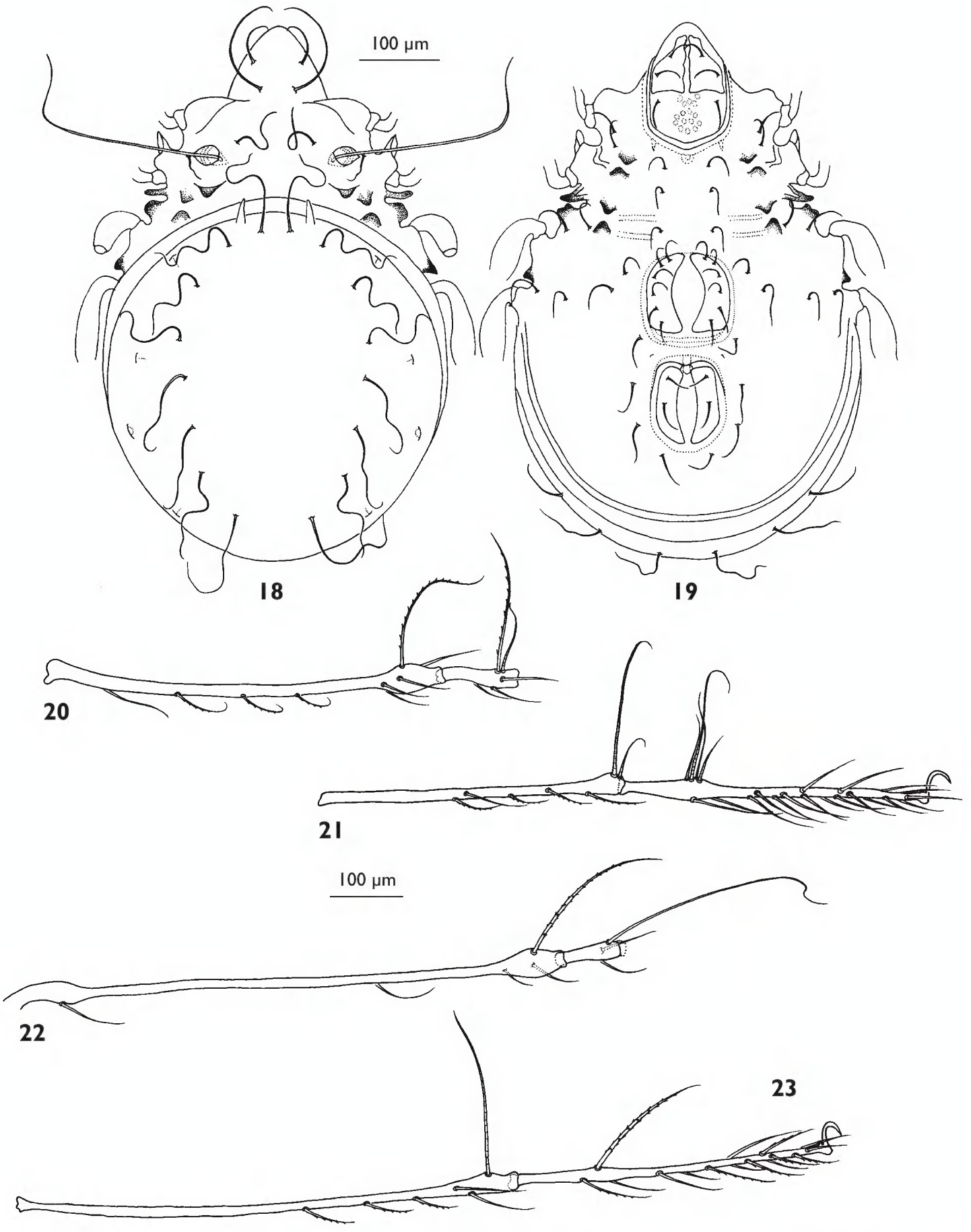
Figs 18–23

Measurements. Mean ventral length: 686 µm (range 656–721); Mean notogastral width: 490 µm (range 465–514).



Figures 18–23. *Tectodamaeus longus* **sp. n. 18** adult, dorsal view **19** adult, ventral view **20** femur and genu of leg I **21** tibia and tarsus of leg I **22** femur and genu of leg IV **23** tibia and tarsus of leg IV.

Integument. Yellowish-brown to reddish- brown in colour. Surface of body and basal part of leg segments except distal half of tarsi with rather thick cerotegument. Notogaster with triangular spinae adnatae and exuviae. Microtuberculate on all enantiophyses and apophyses, rostrum, lateral prodorsum and around leg acetabula. Noto-

gaster and leg segments with adherent debris. Distal parts of all tarsi, and bulb of tarsi III, IV smooth.

Prodorsum. Three pairs tubercles (Da, Ba and Bp) well developed. Propodolateral apophysis (P) strongly developed. Rostral seta (about 117μm) thin. Lamellar seta long (about 196μm), both setae attenuate, smooth, mutual distance of *le* slightly less than that of *ro*. Interlamerllar setae (about 156μm) very long, smooth, flagellate, curling. Exobothridial setae short, undulating attenuate. Sensillus (about 392μm) long, smooth, flagellate, directed dorsolaterad.

Notogaster. Slightly ovate viewed perpendicular to circumgastric scissure, about 1.1 times as long as wide. Spinae adnatae medium in size (about 98μm), curved ventrad, distance between their bases almost equal to that between insertions of interlamellar setae. Notogastral setae very long (mostly 58–137μm), smooth, flagellate, curling. c_1 (about 117μm) directed anterodorsad, relatively thick, curling. c_2 (about 78μm) directed dorsolaterad. *l* and *h* series (mostly 68–137μm), curved posterolaterad. Mutual distance of setae c_2 3 times that of c_1. Pseudanal setae undulating attenuate, ps_1 curved posterolaterad, ps_2 and ps_3 curved laterad. Order in length of the setae: $la = lm < lp < h_3 < c_2 < h_2 < c_1 < h_1$. Lyrifissures *ia*, *im*, *ih*, *ips* and *ip* and lateroopisthosomal gland opening gla well developed.

Ventral region. Coxisterna I with medial pit but without groove leading anteriad from it. Enatiophyses E2 and V present, broadly curved tubercle, represented by low, broadly curved ridge. Enantiophysis V positioned laterally, seta 3*b* not carried on tubercle Vp. Tubercle Sa broadly triangular with tip directed anterolaterad. Sp subquadrangular, in lateral aspect Sp twice as broad as Sa. Discidium smaller than Sp, directed posterolaterad. Ventral setae smooth. Coxisternal setation: 3–1–3–4. Anogenital region normal, seta ad_3 close to anal valves. Raised medial band of anal valve distinct, with undercut lateral margin, fissure *ian* minute, represented by small, inconspicuous pore in anterolateral corner of valve. Anal aperture appreciably narrower than genital one.

Legs. Relative lengths (I-IV) 1: 0.63 : 0.88 : 1.41. Leg IV is very long, about 3.21 times ventral body length. Leg chaetotaxy (famulus included, solenidia in parentheses) – I: 1–9–4(1)–5(2)–20(2); II: 1–7–4(1)–4(1)–18(2); III: 2–5–3(1)–4(1)–18; IV: 1–4–2–5(1)–15. solenidion δ of genu on legs I-III are shorter than respectively coupled protecting seta *d*. Tibia solenidia φ of leg IV is long, tibial solenidion φ_1 on leg I about 3 times as long as φ_2. Femur I 12 times length of trochanter I and tibia I is equal to tarsus I. Femur IV 7 times length of trochanter IV, proximal stalk 6 times length of bulb.

Type Material. 1 Holotype and 3 Paratypes, leaf litter, Mt.Huang (30°16'22.26"N, 118°08'32.09"E), Anhui province, China. 25 May 2008, coll. Zhanyu Hu (IEGU).

Remarks. This new species is similar to *Damaeus flagellatus* (Wang), but is easily distinguished from the latter mainly by the length and chaetotaxy of legs. The present of tubercle (Da, Dp) and the shape of seta *in* are also different.

Etymology. The species name is derived from the latin word *longus*, indicating that legs are very long.

Dicussion

Tectodamaeus has many characters in common with *Damaeus*, but there are two differences by which these can be distinguished from each other (see Table 1). During our ongoing study of the Chinese Damaeidae and our examination of additional material, we discovered that there are many species that have only 2 setae on genu IV. Therefore it is reasonable, to reestablish the subgenus *Damaeus* (*Tectodamaeus*) as a genus in the family Damaeidae.

Table 1. Comparison of distinguishing characters between *Tectodamaeus* and *Damaeus*.

character	*Tectodamaeus*	*Damaeus*
Body size	Large	Large
Body color	Dark	Dark
Dorsosejugal tubercles(Da)	Present	Present
Postbothridial tubercles(Bp)	Present	Present
Epimeral tubercles(E2)	Distinct	Distinct
Leg IV	Longer than body	Longer than body
Protecting seta of tibia on	None of legs	None of legs
Protecting seta of genu on	Legs I, II, III	None of legs
The number of setae on genu IV	2	3

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